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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/642,607	08/19/2003	Brian A. Vaartstra	M4065.0133/P133-B	2821

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EXAMINER	
NOVACEK, CHRISTY L	

ART UNIT	PAPER NUMBER
2822	

DATE MAILED: 12/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/642,607	VAARTSTRA ET AL.
	Examiner	Art Unit
	Christy L. Novacek	2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 October 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *75-91* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *88-91* is/are allowed.

6)☒ Claim(s) *75-87* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the amendment filed October 3, 2005.

Response to Amendment

The limitations added to claims 88 and 89 are sufficient to overcome the rejections of claims 88-91 as being unpatentable over Ovshinsky (US 6,087,674), Lu (US 6,017,818) and Mosely (US 5,877,087). Therefore, these rejections are withdrawn.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 75-85 are rejected under 35 U.S.C. 103(a) as being compatible over Ovshinsky et al. (US 6,087,674, previously cited) in view of Lu (US 6,017,818, previously cited) and Mosely et al. (US 5,877,087, previously cited).

Regarding claim 75, Ovshinsky discloses depositing a single layer (6,8) containing a first metal (titanium), aluminum, nitrogen and boron on a semiconductor substrate as a layer of $M_xAl_yN_zB_w$, wherein M is the first metal (titanium) and x, y and z are each greater than zero (10) (col. 9, ln. 44 – col. 10, ln. 5 of US 6,087,674 patent and col. 10, ln. 33-61 of the parent US 5,825,046 patent). Ovshinsky does not disclose the exact ratio of boron in relation to the elements in the layer. At the time of the invention, it would have been obvious to one of ordinary skill in the art to use routine experimentation to determine an appropriate amount of boron in the layer depending upon the desired electrical properties of the layer. Ovshinsky does

not disclose what method is used to deposit the first layer. Like Ovshinsky, Lu discloses depositing a single layer containing titanium, boron and nitrogen as part of a semiconductor device manufacturing process (Abstract). Lu teaches that this layer is deposited using a particular chemical vapor deposition (CVD) process because it offers the advantages of being able to deposit a layer having good conformality and flow defect density (col. 2, ln. 29-48). Lu's CVD method involves placing a wafer into a CVD chamber, heating the wafer and introducing a metal (titanium) precursor, a nitrogen precursor and a boron precursor into the chamber to simultaneously deposit the Ti-B-N layer (col. 3, ln. 30-55). Lu does not disclose incorporating aluminum into the layer. Like the Ti-B-N layer of Lu, Mosely discloses that an aluminum-containing layer can also be conformally deposited by a CVD process using an aluminum precursor (col. 5, ln. 8-22). At the time of the invention, it would have been obvious to one of ordinary skill in the art to deposit the Ti-Al-N-B layer of Ovshinsky using a CVD process as disclosed by Lu and Mosely because these references teach that CVD will result in a layer that is conformal and of a low defect density and because such variables of art recognized importance are subject to routine experimentation and discovery of an optimum value for such variables is obvious. See *In re Aller*, 105 USPQ 233 (CCPA 1955).

Regarding claim 76, Lu discloses that the single gas serves as the titanium precursor and the nitrogen precursor (Abstract).

Regarding claims 77 and 79, Lu discloses that the titanium and nitrogen precursor can be $Ti(N(CH_3)_2)_4$ (tetra-dimethyl-amido-titanium) (TDMAT) (Abstract).

Regarding claim 78, Lu discloses heating the wafer to a temperature of 300-500°C (col. 3, ln. 47-50).

Regarding claim 80, Mosely discloses that the aluminum precursor is dimethylaluminumhydride (DMAH) (col. 5, ln. 8-22).

Regarding claim 81, Lu discloses that the titanium precursor can be tetrakisdiethylamidotitanium (TDEAT) (col. 6, ln. 51-58).

Regarding claim 82, Lu discloses that the metal (titanium) precursor is an organometallic compound.

Regarding claim 83, Lu discloses that the boron precursor is a boron reactant gas (col. 6, ln. 51-58).

Regarding claims 84 and 85, Lu discloses that a nitrogen precursor is a nitrogen reactant gas.

Claim 86 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ovshinsky et al. (US 6,087,674) in view of Lu (US 6,017,818) and Mosely et al. (US 5,877,087) as applied to claim 75 above, and further in view of Sandhu et al. (US 5,246,881, previously cited).

Regarding claim 86, Ovshinsky, Lu and Mosely do not disclose the structure of the CVD apparatus used to deposit the Ti-Al-B-N layer. Sandhu discloses using a CVD process to deposit a titanium-containing layer from a TDMAT precursor. Sandhu states that in order to form a titanium-containing layer having good film uniformity, a carrier gas is used to vaporize and transport the TDMAT precursor and a bubbler (col. 3, ln. 4-41; col. 6, ln. 13-15). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use a bubbler to provide the titanium precursor because Lu discloses using a TDMAT precursor to CVD

deposited the titanium-containing layer and Sandhu states that by providing a carrier gas with the TDMAT in a bubbler, a titanium-containing film having good uniformity can be formed.

Claim 87 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ovshinsky et al. (US 6,087,674) in view of Lu (US 6,017,818) and Mosely et al. (US 5,877,087) as applied to claim 75 above, and further in view of Ward et al. ("New Developments in CVD Source Delivery and Source Reagents", previously cited).

Regarding claim 87, Ovshinsky, Lu and Mosely do not disclose the structure of the CVD apparatus used to deposit the Ti-Al-B-N layer. Ward discloses it is beneficial to use a liquid source delivery CVD process to deposit a titanium-containing layer from a TDMAT precursor because vapor source delivery CVD methods suffer the problem of being difficult to control and maintain. Ward teaches that direct liquid injection of precursors in a chemical vapor deposition process eliminates those problems. At the time of the invention, it would have been obvious to one of ordinary skill in the art to use a direct liquid injection system to provide of precursors because Lu and Mosely disclose using CVD to deposit the Ti-Al-N-B layer and Ward teaches that by providing the precursors to the CVD chamber by way of a direct liquid injection system, the problems associated with a vapor source delivery system can be avoided.

Response to Arguments

Applicant's arguments filed October 3, 2005 have been fully considered but they are not persuasive.

Regarding the rejection of claim 75 as being unpatentable over Ovshinsky, Lu and Mosely, Applicant argues that one of ordinary skill in the art would allegedly not use CVD to deposit the contacts of Ovshinsky because it is expensive to do so. However, the fact that a combination would not be made by businessmen for economic reasons does not mean that a person of ordinary skill in the art would not make the combination because of some technological incompatibility. See MPEP 2145. Lu's disclosure that the CVD of his invention offers the advantage of a less expensive precursor, higher purity, density, stability, greatly reduced formation of NH_4Cl salts, and lower deposition temperature than standard processes would motivate one of ordinary skill in the art to use Lu's process.

Allowable Subject Matter

Claims 88-91 are allowed.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (571) 272-1839. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CLN
December 14, 2005

ZANDRA V. SMITH
PRIMARY EXAMINER
29 Dec. 2005